Height: width of limpets across different zones

Environment, Water

Rocky Shore Ecology: Holbeck Beach This study was conducted to deduce whether the height to width ratio of limpets altered across the three main zones on the shore: upper, middle and lower. It was carried out on Holbeck Beach, North Yorkshire, where limpets were measured in all three zones using random sampling. We found a significant difference in the height to width ratio between the upper and lower shore and upper and middle shore. This is due to many factors, including the threat of desiccation and strong waves. Limpet Patelle VulgataRocky ShoreEcologyHolbeck Beach

Upper ShoreMiddle ShoreLower ShoreCallipers QuadrentRandom SampleDesiccation INTRODUCTION Common limpets, Patella Vulgata, are found, on rocky shores, wherever there is an area firm enough for attachment on rocks, stones and in rock pools. [1] The common limpet is commonly found on Holbeck shore in relatively high abundance. Patella vulgata are in the taxonomic group gastropoda, and thefamilyacmaeidae. They are abundant on rocky shores of all degrees of wave exposure but a high density of seaweed makes it harder for the Patella Vulgata to attach itself to the rocks, so limpet density is reduced. 2] Patella Vulgata have the ability to use their mucus and their ‘ foot’ to clamp down upon the rock with considerable force. This allows them to remain safely attached at all times, despite strong wave action and the threat of desiccation during low tide. When the limpet is fully clamped onto the rock it is almost impossible to remove them. The common limpet is a temperate species, so is found mainly across Europe, spread from Norway to Portugal. The grey conical shell of Patella Vulgata can reach a width of 6cm and height of 3cm with ridges radiating from the central apex.

The muscular foot of the limpet is usually a yellow colour and attached to the smooth interior of its shell. [3] Limpets graze upon algae, which grows upon the rocks where they live. They can scrape the algae with its radula (a tongue coated with many rows of teeth) as they slowly move across the rock surfaces. The Patella Vulgata always return to the same spot, known as the homing scar, before the tide withdraws. The shells grow to match the contours of the rock in order to form a strong seal, protecting them from desiccation and also predation.

They find their way back to the same spot by using chemical cues, finding their own mucus track and following it back to their home point. [4] Limpets are the prey of a variety of creatures, including seals, fish, shore-birds, starfish and humans. The limpets have two defences: fleeing or clamping down to the rock. They can determine which would be the most effective by detecting chemicals in theenvironment. Patella Vulgata have the general lifep of 10 years but this can be drastically changed by the rate of growth. If there is an excess offood, the limpets grow exceedingly quickly but generally only live for around 3 years.

However, if food is sparse, limpets usually grow very slowly but can live up to 20 years. [5] Patella Vulgata are hermaphrodites and undergo a sex change during their life. At around 9 months they mature as males, but after a couple of years they change sex and become female. Spawning occurs annually, usually during the winter months as it is triggered by rough seas, which disperse the eggs and sperm. [6] The larvae has a pelagic life of about 2 weeks and then settles on rocks at a shell length of about 0. 2 mm, usually in rock pools or areas that are constantly damp. HYPOTHESIS

Our hypothesis states that there will be a difference in the height to width ratio of limpets on different parts ofthe beach: lower, middle and upper. The null hypothesis states that there will be no difference between the height to width ratio of limpets on different parts of the beach: lower, middle and upper. METHOD We visited an exposed rocky shore at Scarborough in order to deduce whether the height to length ratio of limpets changed across different zones of the shore. Initially, we had to identify the different area of the beach and we did this by using different types of seaweed and levels of diversity as an indicator. 7] The upper zone, also known as the high tide zone, does not have enough water to sustain large amounts of vegetation. [8] The predominant organisms are anemones, barnacles, hermit crabs and limpets. The rock pools in this area are inhabited by large seaweed and small fish. The middle shore, or middle tide zone, is submerged by water for approximately half of the cycle. This means that there is the capability to support much more marine vegetation, specifically seaweeds. The organisms found there are more complex and larger in size than further up the shore. 9] The rock pools can provide a suitable habitat for small fish, sea urchins, shrimps and zoo plankton. This area is more diversified than the upper shore. The lower shore, or low tide zone, is mostly submerged underwater. The most noticeable difference of this sub-region is the large diversity of different types of seaweeds. Organisms found in this zone are generally less adapted to periods of dryness. The creatures are generally the largest and most complex organisms on the shore as there are more sources of food as marine vegetation flourishes.

The way that we sampled was random, meaning that every point is equally likely to be selected, and selection of one point does not change the probability of including any other point. [10] Once we had deduced the zones, we picked a random point in the zone, which was always the origin, and used a random number chart to decide how we far would walk before putting down the quadrant. We then measured the height and width of all the limpets inside the quadrant. In order to measure the limpets accurately we used a set of callipers; the callipers were positioned from the posterior end of the shell to the anterior.

On average we measured 27 limpets per zone. We did not calculate a running mean but we knew from other students that variation decreases in the region of 20-25. We collected the data using a simple tally, adding to it during the day. RESULTS Lower to Middle Shore My hypothesis was that there would be a significant difference in the height to length ratio of limpets found between the lower and mid shore. My statistical test gave a t-value of 1. 3 at 52 degrees of freedom. This value is not large enough to give me any confidence that there is a statistically significant difference, as it is below 1. 8; therefore I must reject my hypothesis and accept my null hypothesis that there is no significant difference between the height to length ratio of limpets found between the lower and mid shore. Middle to Upper Shore My hypothesis was that there would be a significant difference in the height to length ratio of limpets found between the mid and upper shore. My statistical test gave a t-value of 3. 3 at 50 degrees of freedom. This value is larger than 2. 70, giving me a 99% confidence that there is a statistically significant difference and therefore I am able to accept my hypothesis. Upper to Lower Shore

My hypothesis was that there would be a significant difference in the height to length ratio of limpets found between the upper and lower shore. My statistical test gave a t-value of 3. 2 at 52 degrees of freedom. This value is again larger than 2. 70 giving me a 99% confidence that there is a statistically significant difference and therefore I am able to accept my hypothesis. CONCLUSIONS The data we collected shows that the smallest limpets found on the Holbeck shore were on the middle shore. We found that, on the lower shore, the limpets had the smallest height but the largest width.

This can be explained as they are the affected most by strong waves and are most at risk of being washed away. To combat these problems they have a shallow but wide shell to give the largest area for the muscular foot to hold onto the rock. Also, the limpets at the bottom of the shore are underwater for the longest time. This means that they have less problems combating desiccation than limpets in the other zones. This allows for a larger circumference of the shell, as it is not as essential to have a perfect seal to the rock. [11]

On the upper shore, the limpets we found were generally taller with a smaller base of their shell. Being far up the beach, they do not have as many strong waves which may wash them from their rock so they do not need as large an area for the muscular foot to grip the rock. However, the smaller circumference lowers the chances of having an imperfection in the shape of the shell compared to the homing scar, meaning that a perfect seal will be created. This is of paramount importance as they spend most of their time exposed and in the sunlight – meaning desiccation could easily occur. 12] To help prevent desiccation, the tall shell allows water to be trapped inside, creating a small pool and allowing the limpet to survive whilst being out of water during low tide. FURTHER DISCUSSION Apart from the threats of desiccation and strong waves, there may be other factors which influence the growth of limpets in different areas on the shore. One factor would be the feeding time available for limpets. [13] Limpets further down the shore spend more time underwater so they have more time to graze where as the limpets further up the shore have very little time under water so have very little grazing time. 14] The amount food eaten may in some way affect the growth patterns and development of the conical shells. Another factor is salinity. When the shore is submerged regularly by sea water, the salinity generally remains stable. However, in areas with an abundance of rock pools may have varied salinity levels. As rock pools constantly dry out, due to exposure to warm temperature, the water evaporates leaving behind the salt. [15] Overtime the salinity levels become high, making the rock pool inhabitable to many creatures, including limpets which can only tolerate normal sea water salinity. 16] Fluctuations in salinity alter the water potential and may cause cells in the limpet to become turgid or flaccid – both of which are dangerous. REFERENCES [1] – RG Evans (1974). Biology of British Limpets: Page 411. Found on 12. 10. 12. [2] – I Cockcroft. Website: Gyllybeach, Common Limpet. Found on 13. 10. 12. [3] - Fish, J. D. & Fish, S. (1996) A student's guide to the seashore. Second Edition. Cambridge

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